configuration where no driving voltage is supplied and FIG. **1**B corresponds to a configuration where a driving voltage is supplied;

[0016] FIG. **2** is a graph showing a relationship of force to displacement of a metal dome structure according to the related art;

[0017] FIG. **3**A is a graph showing a relationship of force to displacement of the gap between the opposing driving electrodes according to the touch panel illustrated in FIGS. **1**A and **1**B;

[0018] FIGS. **3**B and **3**C are views showing a mechanism by which a clicking sensation is implemented on the touch panel illustrated in FIGS. **1**A and **1**B;

[0019] FIGS. **4**A and **4**B are views showing a structure of the touch panel, wherein FIG. **4**A is a perspective view showing separated upper and lower substrates of the touch panel and FIG. **4**B is a cross-sectional view of the touch panel with the upper and lower substrates coupled together;

[0020] FIG. **5** shows an example in which a button input area is delimited on the touch panel;

[0021] FIGS. **6**A and **6**B show a perspective and side view, respectively, of an example of a touch panel in which button areas are delimited respectively on user contact surfaces of upper substrates in the touch panel;

[0022] FIGS. **7**A and **7**B show a perspective and side view, respectively, of an another example of a touch panel in which button areas are delimited respectively on user contact surfaces of upper substrates in the touch panel; and

[0023] FIGS. **8**A to **8**D show various examples in which button areas are configured respectively on touch panels, wherein in the examples, the buttons are provided in the forms of numeric keys, Qwerty keys, icon menus and menu bars, respectively.

[0024] Elements, features, and structures are denoted by the same reference numerals throughout the drawings and the detailed description, and the size and proportions of some elements may be exaggerated in the drawings for clarity and convenience.

DETAILED DESCRIPTION

[0025] The detailed description is provided to assist the reader in gaining a comprehensive understanding of the methods, apparatuses and/or systems described herein. Various changes, modifications, and equivalents of the systems, apparatuses, and/or methods described herein will likely suggest themselves to those of ordinary skill in the art. Also, descriptions of well-known functions and constructions are omitted to increase clarity and conciseness.

[0026] In this description of embodiments, a touch panel is a kind of user input device and may be mounted onto various devices. For example, the touch panel may be a user input device having variable buttons whose types, sizes, shapes, numbers, etc. vary according to an application that is being executed or according to stages of the executed application. However, the touch panel is not limited to this, and may be mounted onto an electronic device including fixed input buttons.

[0027] The touch panel may be used in an electronic device having as a user interface a touch screen in which buttons are displayed on a display therebelow. Specifically, the buttons that are displayed on the display may be numeric keys, Qwerty keys, icon menus, or menu bars, etc., and various combinations in the type, size, shape and/or number of the buttons are also allowed. A display, such as a liquid crystal display (LCD), an organic light emitting diode (OLED) display, etc., may be used with the touch panel, and any other display may also be used along with various combinations in the type, size, shape and/or number, etc. of buttons.

[0028] FIGS. **1**A and **1**B are cross-sectional views showing a touch panel **100** according to an embodiment of the present invention, wherein FIG. **1**A corresponds to a configuration in which no driving voltage V_d is supplied and FIG. **1**B corresponds to a configuration in which a driving voltage V_d is supplied. In FIGS. **1**A and **1**B, dimensions such as the thicknesses of substrates and the electro-rheological fluid, the sizes of particles, etc. are exaggerated for clarity.

[0029] Referring to FIG. **1**A, the touch panel **100** includes a pair of substrates (that is, a lower substrate **110** and an upper substrate **120**), electro-rheological fluid (ERF) **130** filled between the substrates **110** and **120** and sealed, and driving electrodes **140**.

[0030] The lower substrate **110** may be placed on a display of electronic equipment. The lower substrate **110** may be configured so as not to be deformed when a certain attractive force or repulsive force is applied between the lower substrate **110** and the upper substrate **120**. For prevention of deformation, the lower substrate **110** may be made of a hard substance, such as, for example, transparent glass. However, there are situations in which it is advantageous for the lower substrate **110** to be made of a material that is not a hard substance. For example, when the touch panel **100** is attached onto a hard display, the lower substrate **110** may be made of a transparent polymer film.

[0031] An upper or lower side surface of the upper substrate **120** is a user contact surface (S) which a user contacts when generating an input signal. The upper substrate **120** may be deformed when a certain force is applied thereon. For example, when the user contact surface S is pressed by a certain external force or due to local pressure from the electro-rheological fluid **130**, the upper substrate **120** may be deformed. In order to provide such deformation, the upper substrate **120** may be made of a transparent, deformable polymer film or the like. Also, the upper substrate **120** may be spaced apart from the lower substrate **10**, so that a gap is formed between the upper substrate **120** and the lower substrate **110**. The gap may be a predetermined distance.

[0032] The electro-rheological fluid **130** is filled in the gap between the lower substrate **110** and the upper substrate **120** and sealed. In order to seal the electro-rheological fluid **130**, a sealant **150** (see FIG. **4**B) may be applied to facing edge portions of one or both of the upper and lower substrates **110** and **120**. The electro-rheological fluid **130** is a suspension in which fine particles **134** are dispersed in electro-insulative fluid **132**. For example, a size of the particles **134** may be on the order of about a hundred microns. The viscosity of the electro-rheological fluid **130** varies maximally by 100,000 times when an electric field is applied thereto, and since such variation in viscosity is reversible, the viscosity returns to its original level when the electronic field disappears. The variation in viscosity caused when an electric field is formed in the electro-rheological fluid **130** will be described in more detail with reference to FIG. **1**B, below.

[0033] The electro-insulative fluid **132** of the electro-rheological fluid **130** may be a transparent liquid such as, for example, silicon oil, kerosene mineral oil, olefin (PCBs), or the like. However, the electro-insulative fluid **132** may be any other material that possesses similar properties of low viscosity change with changing temperature, high flash point, low